

COPY FOR IB

PCT/KR2005/000150

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

REC'D 20 JUN 2005

To:

NAM, Seung-Hee

12F, Seo-Jeon Bldg., 1330-9, Seocho-Dong, Seocho-Gu,
Seoul 137-858, Republic of Korea

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year) 31 MAY 2005 (31.05.2005)Applicant's or agent's file reference
PCT000026

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/KR2005/000150

International filing date (day/month/year)

14 JANUARY 2005 (14.01.2005)

Priority date(day/month/year)

15 JANUARY 2004 (15.01.2004)

International Patent Classification (IPC) or both national classification and IPC

IPC7 H01L 33/00

Applicant

SEOUL OPTO-DEVICE CO., LTD. et al

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/KR



Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM, Dong Yup

Telephone No. 82-42-481-5749



**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/KR2005/000150

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

- ☐ a sequence listing
☐ table(s) related to the sequence listing

b. format of material

- ☐ in written format
☐ in computer readable form

c. time of filing/furnishing

- ☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

**WRITTEN OPINION OF THE
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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-11	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	1-11	YES
	Claims	NONE	NO
Industrial applicability (IA)	Claims	1-11	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1 : JP 2000-294837 A D2 : JP 11-40846 A
D3 : JP 2000-36619 A D4 : WO 02/099901 A1

The present application is related to a III-V group compound semiconductor device comprising : GaN-based semiconductor layers; and an ohmic electrode layer formed on the GaN-based semiconductor layers wherein the ohmic electrode layer comprises a contact metal layer, a reflective layer, and a diffusion layer and a manufacturing method thereof.

D1 relates to a GaN-based LED device in which the p-typed electrode is composed of Au/Ti/Ag(Pt)/Ni multilayers formed on a p-type GaN layer. D1 discloses the structure of the p-typed electrode containing a contact metal layer and a reflective metal layer. But D1 does not explain an addition of a diffusion barrier layer.

D2 also relates to a GaN-based LED device wherein a metal layer of an alloy containing a specific metal is provided in contact with a p-typed GaN semiconductor, and a Pt layer is laminated on the metal layer, and an Au-containing metal layer is laminated thereon. D2 discloses the p-typed electrode structure containing a metal layer and a diffusion barrier layer(Pt layer), but D2 does not suggest the existence of a reflective layer like as a Ag or Al layer in the p-typed electrode of the GaN-based LED device.

D3 discloses a GaN-based LED device in which the p-typed electrode is composed of a reflective a layer and a metal contact layer. But there is no explanation of a diffusion barrier layer in the p-typed electrode in D3.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of :

BOX V.

D4 discloses an annealing process of a p-typed electrode of a GaN-based compound semiconductor device. In D4, the thermal treatment is split into a first thermal treatment and a second treatment; and the first thermal treatment is carried out in an oxygen-containing atmosphere at a comparatively low temperature, and a second thermal treatment is carried out in an oxygen-free atmosphere which is at a comparatively high temperature. In a point that the annealing process is carried in an oxygen atmosphere, the technical feature of D4 is similar to the annealing process of this application. But D4 does not disclose the p-typed electrode which contains a contact metal layer, a reflective layer, and a diffusion barrier layer successively.

As explained above, none of the documents D1-D4 refers to the p-typed electrode which contains a contact metal layer, a reflective layer, and a diffusion barrier layer successively.

Therefore, D1-D4 are considered to be little relevant to the present application.

Compared with the prior art as cited in the International Search Report, the present invention(claims 1-11) is believed to be novel and to involve an inventive step under PCT Article 33(2) and 33(3).

And the present invention has industrial applicability under PCT Article 33(4).

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